2022

Emergency Drugs in Pediatrics

Drug doses and preparation & pediatric formulae

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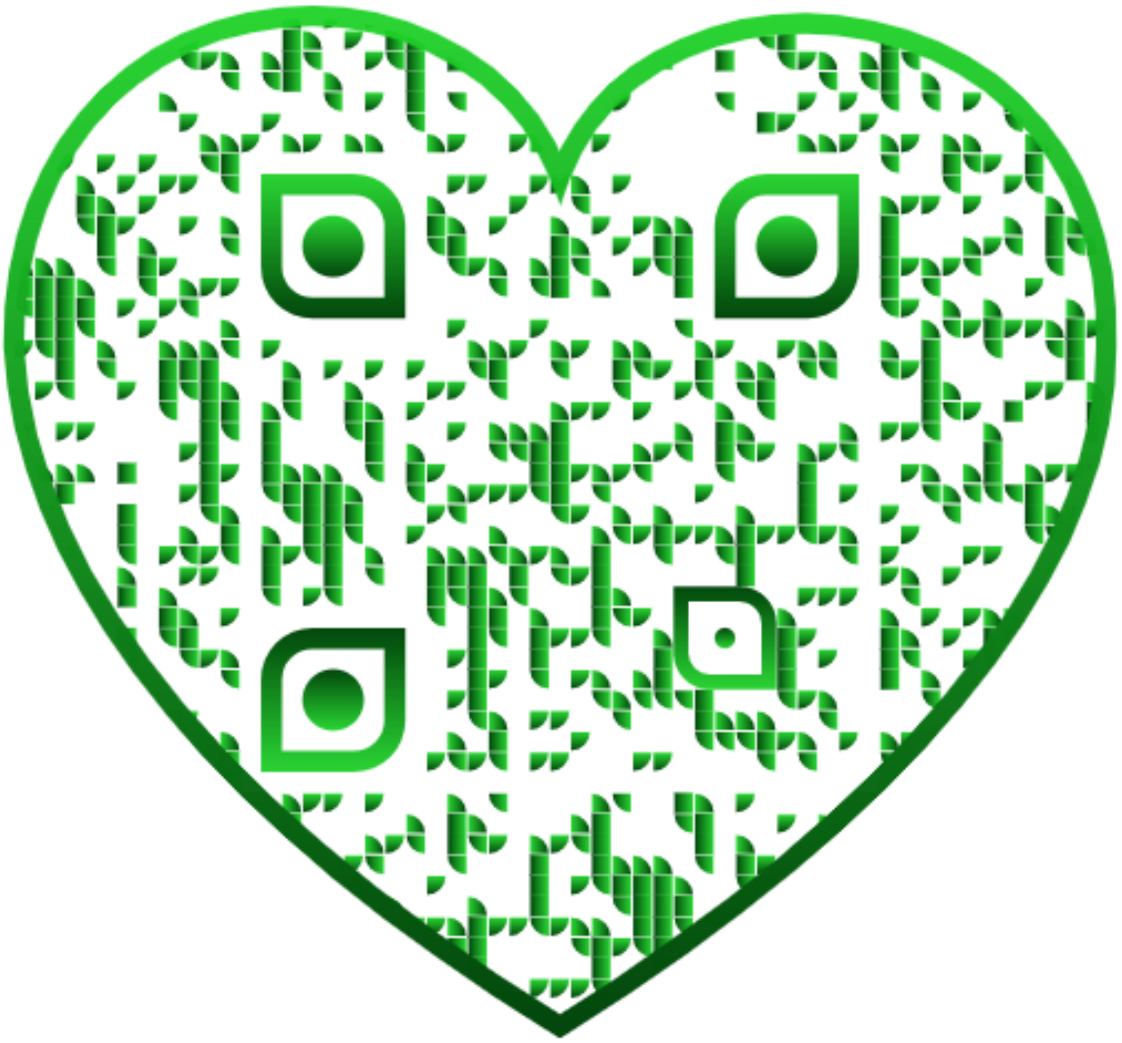


Contents

Cover page 0
Contents 1
Pediatric drug forms 3
How to calculate intermittent doses? 4
How to calculate continuous IV infusion? 5
Inotropes & vasoactive drugs 6
Adrenaline 7
Noradrenaline 8
Dopamine 8
Dobutamine 9
Milrinone 9
Terlipressin 10
Alprostadil 10
Anti-failure drugs 12
Furosemide 13
Spironolactone 14
Anti-arrhythmic drugs 15
Adenosine 16
Amiodarone 17
Atropine 18
Propranolol 19
CNS drugs (anticonvulsant-sedatives- analgesics**)** 20
Phenytoin 21
Midazolam 21
Fentanyl 22
Morphine 23
Ketamine 24
Fluids & Electrolytes 25
Isotonic saline 26
Hypertonic saline 26
Mannitol 26
Dextrose 10 % 27
Magnesium sulfate 27
Calcium gluconate 27
Potassium chloride 28
Bicarbonate sodium 29

ALGRAWANY

Corticosteroids 30
Dexamethasone 31
Hydrocortisone 31
Methylprednisolone 32
Equations & formulae 33
PEDIATRIC PARAMETERS AND EQUIPMENT 34
Common pediatric equations 35
Acid base equations 39
Mechanical ventilation formulae 41
REFERENCES 42

The most common drug form in pediatrics

Liquid form

oral

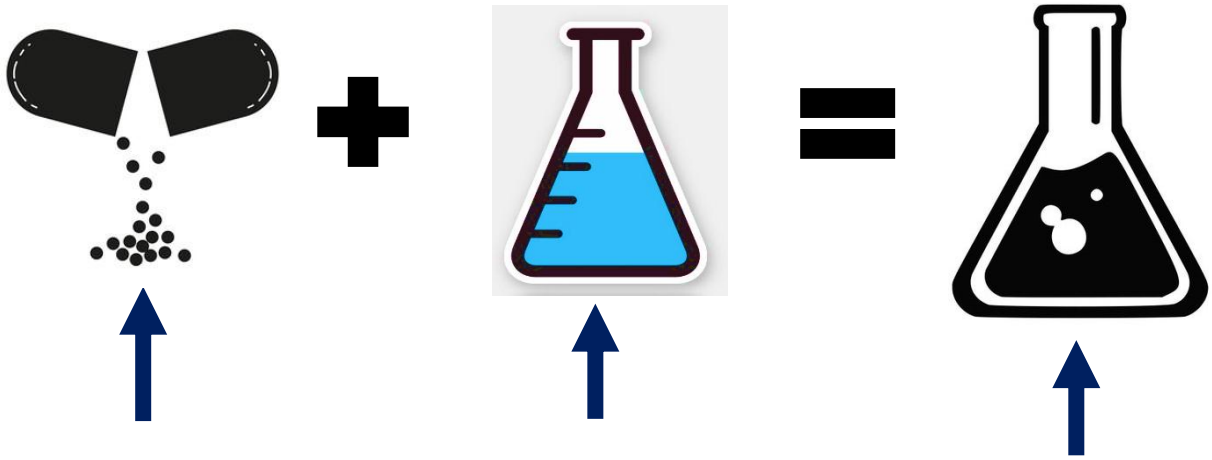
- **Solutions**

Example: syrup

- **Tablets dissolved in DW**

parenteral

- **Injections**



Amount:	**Volume:**	**Concentration:**
mg – g – mEq etc.	**Liter- ml etc.**	**mg/ml - mEq/ml**

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How to calculate intermittent doses?

Doses in pediatrics are based on:

- Body weight …….. (5 mg/kg)
- Body surface area "BSA" ……. (5 mg / m^2)
- Age …… (2-6 yrs. >>> 5 mg/day)

Example:

1 year-old infant, his *weight 10 kg*, desired drug *dose 5 mg/kg/8hr.*, drug *concentration 25 mg/ml,* calculate the dose for this infant.

Desired dose = 10 kg X 5 mg = 50 mg

How to give the infant this dose as volume in ml?

25 mg …….. 1 ml

50 mg (10kg X 5mg) ……..?? ml

$$\textbf{Dose} = \frac{\boldsymbol{10\ kg\ X\ 5\ mg\ X\ 1\ ml}}{\boldsymbol{25\ mg}} = \boldsymbol{2\ ml}$$

Dose = weight X dose X مقلوب التركيز = … ml

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How to calculate continuous IV infusion?

1. we calculate total amount of drug in 24 hours as follow:

- ***If the dose mcg/kg/minute:***

$$= \frac{\text{Weight X dose(mcg)X 24 X60}}{\text{concentration (mcg/ml)}} = \cdots ml$$

- ***If the dose mcg/kg/hour:***

$$= \frac{\text{Weight X dose(mcg)X 24}}{\text{concentration (mcg/ml)}} = \cdots ml$$

2. We dilute this amount in compatible solution and infuse it over 24 hours as follow:

ناتج المعادلة بالمل يستكمل حتى **24 مل** محلول ملح أو جلوكوز 5 % ويعطى على مدار 24 ساعة بمعدل **1 مل** / الساعة

أو

يستكمل حتى **12 مل** محلول ملح أو جلوكوز 5 % ويعطى على مدار 24 ساعة بمعدل **نصف مل** / الساعة

INOTROPES

&

Vasoactive drugs

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Adrenaline

Concentrations

ادرينالين

1 mg/ ml (1 : 1000)

0.25 mg / ml

Indications

1. Cardiac arrest

1 مل يستكمل حتى 10 مل محلول ملح ..... Amp 1mg/ml

1 مل يستكمل حتى 2.5 مل محلول ملح ..... Amp 0.25mg/ml

NRP 1:10000

Dose:

IV/IO: 0.2 ml/kg ..... اتنين شرطة لكل كيلو من المحلل

ETT: 1 ml/kg ..... 1 سم لكل كيلو من المحلل

PALS IV: 1:10000 ETT: 1:1000

Dose:

IV/IO: 0.1ml/kg ..... شرطة لكل كيلو من المحلل

ETT: 0.1ml/kg ..... شرطة لكل كيلو من **غير** المحلل

2. Shock

Dose:

Continuous IV infusion: 0.05 – 0.3 mcg/kg/min (up to 1 mcg)

$$\frac{\textbf{Weight X dose } (0.05\text{-}0.3) \textbf{ X 24 X 60}}{\textbf{1000}} = \textbf{... ml}$$

الرقم اللي هيطلع يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

3. Anaphylactic shock

Dose:

IM in anterolateral thigh of 1:1000 conc.

Less than 6 years	0.15 ml ... 100 وحدة بسرنجة انسولين 15
6 – 12 years	0.3 ml .... 100 وحدة بسرنجة انسولين 30
More than 12 years	0.5 ml نصف مل....

في حالة استخدام سرنجة انسولين يراعى تغيير السن الى سن عضل حيث ان الجرعة تعطى عضل

4. Stridor

Dose:

Nebulized 0.5ml/kg of 1:1000 conc. (maximum 5 ml = 5mg)

Stability: For infusion prepare fresh solution every 24 hrs.

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Norepinephrine

Concentrations

نورادرينالين

1 mg / ml = 1000 mcg / ml

(there is another concentration 2mg/ml in the market ; 1 ml contains 2 mg noradrenaline tartrate equivalent to 1 mg noradrenaline base so it's actual concentration 1mg/ml too)

Indications

Septic Shock

Dose:

Continuous IV infusion: 0.2 – 2 mcg/kg/min

$$\frac{\textbf{Weight X dose } (0.2\text{-}2) \textbf{ X 24 X 60}}{\textbf{1000}} = \textbf{... ml}$$

الناتج يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

Stability: For infusion prepare fresh solution every 24 hrs.

Dopamine

Concentrations

دوبامين

40 mg / ml = 40000 mcg / ml

Indications

Shock

Dose:

Continuous IV infusion: 5-20 mcg/kg/min

$$\frac{\textbf{Weight X dose } (5\text{-}20) \textbf{ X 24 X 60}}{\textbf{40000}} = \textbf{... ml}$$

الرقم اللي هيطلع يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

Stability: For infusion prepare fresh solution every 24 hrs.

Dobutamine

Concentrations

دوبيوتامين

250 mg / 20 ml = 12500 mcg / ml

250 mg / 5 ml = 50000 mcg / ml

Indications

cardiogenic Shock

Dose:

Continuous IV infusion: 2 -20 mcg/kg/min

$$\frac{\textbf{Weight X dose } (2\text{-}20) \textbf{ X 24 X 60}}{\textbf{12500 } \textit{or} \textbf{ 50000}} = \textbf{... ml}$$

الرقم اللي هيطلع يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

Stability: For infusion prepare fresh solution every 24 hrs.

Milrinone

Concentrations

Primacor بريماكور

1 mg / ml = 1000 mcg / ml

Indications

Cardiogenic Shock/PPHN

Dose:

- Loading >> 50 mcg/kg over 15 min iv infusion

$$\frac{\textbf{Weight X dose } (50)}{\textbf{1000}} = \textbf{... ml}$$

الرقم اللي هيطلع يستكمل 10 مل محلول ملح ويهطى وريدي على مدار ربع ساعة

- Maintenance >> 0.25 – 0.75 mcg/kg/min

$$\frac{\textbf{Weight X dose } (0.25\text{-}0.75) \textbf{ X 24 X 60}}{\textbf{1000}} = \textbf{... ml}$$

الرقم اللي هيطلع يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

Stability: For infusion prepare fresh solution every 24 hrs.

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Terlipressin

Concentrations

Glypressin جليبرسين

1 mg / 5 ml = 200 mcg / ml

Indications

Refractory septic shock

Dose:

- Loading >> 20 mcg/kg over 15 min iv infusion

$$\frac{\textbf{Weight X dose } (20)}{\textbf{200}} = \dots \textbf{ ml}$$

الرقم اللي هيطلع يستكمل 10 مل جلوكوز 5 % ويعطى وريدي على مدار ربع ساعة

- Maintenance >> 4-20 mcg/kg/hr

$$\frac{\textbf{Weight X dose } (4\text{-}20) \textbf{ X 24}}{\textbf{200}} = \dots \textbf{ ml}$$

الرقم اللي هيطلع يستكمل حتى 24 مل محلول ملح ويعطى وريدي بمعدل 1 مل في الساعة على مدار 24 ساعة

Alprostadil

Concentrations

Prostin ampoule بروستين

500 mcg/ml

Indications

Duct dependent congenital heart disease

Dose: *continuous IV infusion*

- **initia**l 0.05 – 0.1 mcg/kg/min
- **maintenance** 0.01 mcg/kg/min

$$\textbf{dose} = \frac{\textbf{Weight X dose } (0.05\text{-}0.1 \text{ mcg}) \textbf{ X 24 X 60}}{\textbf{500}} = \dots \text{ ml}$$

الناتج يستكمل حتى 24 مل جلوكوز 5 % ويعطى بمعدل 1 مل في الساعة

Side effects: apnea, hypotension, bradycardia and hypokalemia

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Heparin sodium

Concentrations

5000 I.U./ml

Indications

Maintaining patency of central vascular catheter

Patient on IV fluids

Dose: 0.5-1 unit/ml ✝

يحل 1 مل من الهيبارين في 500 مل جلوكوز 5%
ويضاف 5 مل من المحلل لكل 100 مل من المحاليل

Patient only on IV drugs

1- Continuous IV infusion:

Dose: 0.5 unit/kg/hr ⁎

يحل 1 مل من الهيبارين في 500 مل جلوكوز 5%

$$= \frac{weight\ X\ 0.5\ X\ 24}{10} = \cdots ml$$

الرقم اللي هيطلع يستكمل حتى 12 مل جلوكوز 5% و
يعطى على مدار 24 ساعة بمعدل نصف مل في الساعة

2- Intermittent flush:

Dose: 1–2 mL of 10 U/mL solution Q4 hr ®

(instill enough volume to fill lumen of catheter)

Prepare fresh solution every 24 hrs.

✝ The_Harriet_Lane_Handbook_22nd edition ✝Gomella's neonatology textbook
⁎ Neofax 2020
® Medscape 2021

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Anti-failure drugs

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Furosemide

Concentrations

Lasix لازكس

Oral: Genesemide 20 mg/5ml
Tablets: 40 mg – 20 mg
Ampoule: 10 mg/ml

Indications

- **Loop duiretics in Oedema in heart failure, renal disease, and hepatic disease | Pulmonary oedema:**

Infant & children	Neonates
P.O: Start at 2 mg/kg/dose; may increase by 1–2 mg/kg/dose no sooner than 6–8 hr following the previous dose. **Max. dose**: 6 mg/kg/dose. Dosages have ranged from 1–6 mg/kg/dose Q12–24 hr. **Adult:** 20–80 mg/dose Q6–12 hr; max. dose: 600 mg/24 hr	**Initial Dose:** 1 mg/kg IV, IM, or orally. May increase to a maximum of 2 mg/kg/dose IV or 6 mg/kg/dose orally. **Initial Intervals:** **Premature infant:** every 24 hours. **Full-term infant:** every 12 hours. **Full-term infant older than 1 month:** every 6 to 8 hours. Consider alternate-day therapy for long-term use.
IV: 1–2 mg/kg/dose Q6–12 hr; max. dose: 6 mg/kg/dose not to exceed 200 mg/dose ***Adult***: 20–40 mg/24 hr ÷ Q6–12 hr; max. dose: 200 mg/dose	
Continuous IV infusion: 0.1 mg/kg IV bolus followed by 0.05–0.4 mg/kg/hr infusion and titrate to effect	

Side effects:

Hearing loss in premature neonate
Hypokalemia, hyponatremia
Hypercalciuria, nephrocalcinosis and nephrolithiasis
Hypomagnesemia
Metabolic alkalosis (contraction alkalosis)

Warning

Monitor

UOP

Blood pressure

Electrolytes

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Spironolactone

Concentrations

Spectone or Aldactone سبكتون/الداكتون

Tablets: 25 mg

Indications

Potassium sparing duiretics in Oedema in heart failure

Infant & children	Neonates
1–3 mg/kg/24 hr ÷ BID–QID PO; **max. dose** 4–6 mg/kg/24 hr or 400 mg/24 hr	1–3 mg/kg/24 hr ÷ once or twice daily PO

Warning

Monitor

Serum potassium closely

Side effects:

hyperkalemia
hyponatremia
Gynecomastia in males

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Anti-arrhythmic drugs

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Adenosine

Concentrations		
Adenocor ampoule	3mg/ml	**ادينوكور**

Indications

SVT

Infant and children:

Dose:

- ***1st dose*** 0.1 mg/kg/ IV bolus (max 6mg for dose).
- ***2nd dose*** 0.2 mg/kg if no response

$$\frac{\textbf{Weight X dose } (0.1\text{mg})}{3} = \dots \textbf{ ml}$$

Neonate: *must be diluted in 10 ml NS due to small weights*

Dose:

- 50 mcg/kg 1 مل يستكمل حتى 10 مل محلول ملح

$$\frac{\textbf{Weight X dose } (50\text{ mcg})}{300} = \dots \textbf{ ml}$$

- ***Given through peripheral line near to the heart***
- ***Three-way technique: push adenosine then flush with 10 ml normal saline***
- ***Attach baby to monitor***
- ***Prepare defibrillator***

Storage:

- Store at controlled room temperature of 15-30°C
- ***Do not refrigerate***; possible crystal formation.
- Shelf life Unopened: 36 months.
- The product should be used immediately after opening.
- ***Discard*** unused portion

- ***Warning:***
  - 2nd or 3rd degree AV block (except those on pacemakers)
  - Sinus node disease, such as sick sinus syndrome or symptomatic bradycardia (except in patients with a functioning artificial pacemaker)
  - Contraindicated in bronchospasm e.g.: asthma

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Amiodarone

Concentrations		
Cordarone ampoule	150 mg / 3ml = 50 mg / ml	**كورداورون**

Indications

1- Pulseless VT or VF

"PALS" during cardiac arrest in shokable rhythm as 3rd line after DC and adrenaline

Dose: 5 mg/kg dose IV bolus $= \frac{weight\ X\ dose(5mg)}{50} = \cdots ml$

2- Cardiac arrhythmias according to indication (cardiologist consultation)

Loading dose: 5mg/kg/dose over 1hr once or may be followed by IV infusion 5mcg/kg/min

Final concentration should be 1.5mg/ml

Dilute 150mg(3ml) in 100ml D5W..... يحل 3 مل في 100 مل جلوكوز 5 %

Loading dose: $= \frac{weight\ X\ dose(5mg)}{1.5} = \cdots ml$

الناتج يعطى على مدار ساعة

Maintenance dose: $= \frac{weight\ X\ dose(5mcg)\ X\ 24\ X\ 60}{1500} = \cdots ml$

الناتج يعطى على مدار 24 ساعة

- Amiodarone is incompatible with saline and should be administered solely in 5% dextrose solution.
- For single dose use only. Discard any unused solution immediately after initial use.
- Should be administered solely in 5% w/v Glucose Intravenous Infusion.
- Must not be mixed with other medicinal products in the same syringe.

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Atropine

Concentrations

Atropine sulphate ampoule	1mg/ml	**اتروبين**

NB: May be present in multiple concentrations

Indications

- ***Prevention of bradycardia in rapid sequence intubation:***
  - ***Neonate:*** 0.01–0.02 mg/kg/dose IV (over 1 min)/IM prior to other premeditations.
  - ***Child:*** 0.02 mg/kg/dose IV/IO/IM; **max. dose**: 0.5 mg/dose
  - ***Adult:*** 0.5 mg/dose IV/IM
- ***Vagally mediated bradycardia unresponsive to oxygenation, ventilation and adrenaline:***
  - ***Child:*** 0.02 mg/kg/dose IV/IO/IM (use 1 mg/mL for IM) Q5 min × 2–3 doses PRN; **max. single dose**: 0.5 mg in children, 1 mg in adolescents; **max total dose**: 1 mg children, 2 mg adolescents
  - ***Adult:*** 0.5–1 mg/dose IV Q5 min; **max. total dose**: 3 mg
- ***Organophosphate or carbamate poisoning in bradycardia, bronchorhea or bronchospasm:***
  (IV/IO/IM/ET; dilute in 1–2 mL NS for ET administration)
  - **Child:** 0.05–0.1 mg/kg Q 5–10 min until bronchial or oral secretions terminate.
  - **Adolescent:** 1–3 mg/dose Q 3–5 min until bronchial or oral secretions terminate.
  - **Adult:** 2–5 mg/dose Q3–5 min until bronchial or oral secretions terminate

Side effects include: dry mouth, blurred vision, fever, tachycardia, constipation, urinary retention, CNS signs (dizziness, hallucinations, restlessness, fatigue, and headache).

يحل 1 مل في 10 مل محلول ملح ليصبح التركيز النهائي 0.1 مجم/مل و تحسب الجرعة كالتالي

$$= \frac{weight\ X\ dose(0.02mg)}{0.1} = \cdots ml$$

In RSI **"0.02 mg/kg"**

يعطى الوزن / 5 بالمل من المحلل

In Organophosphate poisoning **"0.05 mg/kg"**

يعطى نصف الوزن بالمل من المحلل

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Propranolol اندرال

Concentrations

Inderal Tabs: *10, 40mg* ***Inderal ampoule*** *1 mg/ml*

Indications

- ***Arrhythmias:***
  - ***IV:*** 0.01–0.1 mg/kg/dose IV push over 10 min, repeat Q6–8 hr PRN; **max. dose:** 1 mg/dose for infant; 3 mg/dose for child
  - ***PO:*** Start at 0.5–1 mg/kg/24 hr ÷ Q6–8 hr; increase dosage Q3–5 days PRN. Usual dosage range: 2–4 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 60 mg/24 hr or 16 mg/kg/24 hr
- ***Tetralogy spells:***
  - **IV:** 0.15–0.25 mg/kg/dose slow IV push. May repeat in 15 min ×1.
  - **PO:** Start at 2–4 mg/kg/24 hr ÷ Q6 hr PRN. Usual dose range: 4–8 mg/kg/24 hr ÷ Q6 hr PRN. Doses as high as 15 mg/kg/24 hr have been used with careful monitoring.
  - ***(Oral route is safer)***

Contraindicated in asthma, Raynaud syndrome, heart failure, and heart block. **Not indicated** for the treatment of hypertensive emergencies. **Use with caution** in presence of obstructive lung disease, diabetes mellitus, or renal or hepatic disease. May cause **hypoglycemia**.

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CNS drugs (anticonvulsants- sedatives- analgesics)

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Phenytoin

Concentrations

Epanutin 250 mg/ 5 ml = 50 mg / ml

Indications

Status epilepticus

Loading: 15-20 mg/kg/dose IV over 30 min **max. dose:** 1500 mg/24 hr

Maintenance: 4-8 mg/kg/day divided every 12 hrs.

$$= \frac{weight\ X\ dose}{50} = \cdots ml$$

Every ml diluted in 10 ml normal saline

*Must be diluted in normal saline **DO NOT** dilute in D5W*

Midazolam

Concentrations

15 mg / 5 ml = 5 mg / ml

Indications

Infant & children

- ***Anticonvulsant:***

Intermittent IV boluses: 0.2 mg/kg

(up to 10 mg total dose)

1 مل يستكمل حتى 5 مل محلول ملح ويعطى 2 شرطة لكل كيلو

continuous IV infusion: 1-34 mcg/kg/min

IM: 0.2 mg/kg (undiluted)

intranasal: 0.2 mg/kg (undiluted)

Buccal: 0.5 mg/kg (undiluted)

- ***Sedation:***

Intermittent IV boluses: 0.1 mg/kg/dose

1 مل يستكمل حتى 5 مل محلول ملح ويعطى شرطة لكل كيلو

continuous IV infusion: 1-2 mcg/kg/min

$$= \frac{weight\ X\ dose\ X\ 24\ X\ 60}{5000} = \cdots ml$$

الرقم اللي هيطلع يستكمل حتى 24 مل جلوكوز 5% و يعطى على مدار 24 ساعة بمعدل مل في الساعة

Neonates

- ***Anticonvulsant:***

Intermittent IV boluses: 0.15 mg/kg/dose

1 مل يستكمل حتى 5 مل محلول ملح ويعطى شرطة لكل كيلو

continuous IV infusion: 1-7 mcg/kg/min

- ***Sedation:***

Intermittent IV boluses: 0.1 mg/kg/dose

1 مل يستكمل حتى 5 مل محلول ملح ويعطى شرطة لكل كيلو

continuous IV infusion: 1 mcg/kg/min

Intranasal: 0.2 mg/kg/dose undiluted

sublingual: 0.2 mg/kg/dose undiluted

$$= \frac{weight\ X\ dose\ X\ 24\ X\ 60}{5000} = \cdots ml$$

الرقم اللي هيطلع يستكمل حتى 24 مل جلوكوز 5% ويعطى على مدار 24 ساعة بمعدل مل في الساعة

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Fentanyl

Concentrations

فينتانيل

100 mcg / 2ml = 50mcg /ml

Indications

Analgesia / sedation

Infant & children	Neonates
Intermittent IV boluses: 1-2 mcg/kg/dose usually every 2-4hrs **continuous IV infusion:** 1-3 mcg/kg/hr	**Intermittent IV boluses:** **Analgesia** 0.5- 3 mcg/kg/dose (every 2- 4hrs) **Sedation** 0.5- 4 mcg/kg/dose (every 2- 4hrs) **continuous IV infusion:** **Analgesia** 0.5 -2 mcg/kg/hr **Sedation** 1-5 mcg/kg/hr

Final concentration should be 10 mcg / ml

IV bolus

1 مل يستكمل حتى 5 مل جلوكوز 5%

$$= \frac{weight\ X\ dose(0.5 - 4mcg)}{10} = \cdots ml$$

continuous IV infusion

$$= \frac{weight\ X\ dose(0.5 - 5mcg)\ X\ 24}{50} = \cdots ml$$

الرقم اللي هيطلع يستكمل حتى خمسة أضعاف جلوكوز 5% و يعطى على مدار 24 ساعة

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Morphine

Concentrations

مورفين

Morphine sulphate ampoule **10 mg/ml**

Indications

Analgesia / sedation

Infant & children	Neonates
Intermittent IV boluses: 0.05- 0.2 mg/kg/dose (every 4hrs)	**Intermittent IV boluses:** 0.05- 0.2 mg/kg/dose (every 4hrs)
continuous IV infusion: Postoperative pain: 0.01–0.04 mg/kg/hr Sickle cell and cancer: 0.04–0.07 mg/kg/hr	**continuous IV infusion:** 0.01 - 0.02 mg/kg/hr

Final concentration should be 0.1 mg / ml

IV bolus "0.1 mg/kg"

نصف مل يستكمل حتى 50 مل جلوكوز 5% او محلول ملح و يعطى 1 مل لكل كيلو من المحلل

$$= \frac{\text{weight X dose}(0.05 - 0.2\text{mg})}{0.1} = \cdots \text{ml}$$

continuous IV infusion

نصف مل يستكمل حتى 50 مل جلوكوز 5% او محلول ملح

$$= \frac{\text{weight X dose}(0.01\text{ mg}) \text{ X } 24}{0.1} = \cdots \text{ml}$$

الناتج يعطى على مدار 24 ساعة

- Avoid IM injection
- Avoid in (liver cell failure, ICP & renal impairment)
- Be aware of respiratory depression, hypotension and constipation
- **Antidote:** Naloxone may be used to reverse effects, especially respiratory depression at a dose 0.1 mg/kg/dose and repeat every 2-3 minutes

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Ketamine

Concentration

كيتالار

Ketalar 50 mg/ml

Indications

- **Induction and maintenance of anesthesia for short procedures:**

IV: 1-2 mg/kg for 1 dose **max. dose:** 150 mg/dose (usually produces 5-10 minutes of surgical anesthesia)

يحل 1 مل في 50 مل محلول ملح ويعطى **الوزن** او **ضعف الوزن** من المحلل بالمل وريدي

. **IM:** 4 mg/kg/dose (usually produces 15 minutes of surgical anesthesia)

$$= \frac{weight\ X\ dose(4\ mg)}{50} = \cdots ml$$

- **Analgesic** & **sedative**
- **Bronchodilator** ….. Of choice in asthma
- **Increase blood pressure** …. Of choice in shock
- **Previously not used in raised ICP** but ketamine no longer contraindicated in increased ICP conditions and can be used safely for intubating patients with TBI.
- **Avoid** below 3 months

Side effects:

- Hypertension
- Increase airway secretions(atropine may be used in RSI)

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Fluids & Electrolytes

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Isotonic saline

Concentrations

NaCl 0.9% = 154 mEq/L of sodium

Indications

Shock:

- **Infant& child:** 20 ml/kg IV over 5 minutes
- **Cardiogenic shock:** 5-10 ml/kg over 10-20 minutes
- **DKA:** 10 ml/kg over 1 hr
- **Neonate:** 10 ml/kg over 10-15 min

Hypertonic saline

Concentrations

NaCl 3% = 500 mEq/L of sodium

Indications

Infant & children	Neonate
Symptomatic hyponatremia: ***"seizures"*** 4-6 ml/kg IV over 30 minutes ✝ **Brain edema:** **DKA:** 2-4ml/kg/dose IV over 30 minutes ⁎ **TBI (traumatic brain injury):** 5-10 ml/kg IV over 30 minutes ✝ ✝ *NELSON 2020* ⁎ *pediatric critical care manual*	**Symptomatic hyponatremia:** ***"seizures"*** 1-2 ml/kg IV over 15 minutes ® ® *GOMELLA*

Mannitol

Concentrations

10% = 10 grams / 100 ml **or** 20% = 20 grams / 100 ml

Indications

Brain edema: *"contraindicated in renal impairment"*

- **DKA:** 0.5-1 g /kg/dose IV over 30 minutes
- **TBI (traumatic brain injury):** 0.25- 1 g / kg / dose over 30 minutes
-

$$= \frac{weight\ X\ dose\ X\ 100}{10\ or\ 20} = \cdots ml$$

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Dextrose 10 %

Concentrations

10% = 10 grams/ 100 ml

Indications

- **Symptomatic hypoglycemia:**
  - *Infant & children:* 4ml /kg IV
  - *Neonate:* 2ml/kg IV (4 ml/kg if with seizures)

Magnesium sulfate

Concentrations

10% = 100 mg/ml

Indications

Refractory status asthmaticus

Dose: 25- 75 mg/kg/dose IV over 20 minutes

(Usual dose 50 mg/kg .....نصف الوزن يخفف ويعطى علي مدار 20 دقيقة وريدي)

Hypomagnesaemia

IV/IM: 25–50 mg/kg/dose Q4–6 hr × 3–4 doses; repeat PRN. Max. single dose: 2 g

Warning: it may cause hypotension

Calcium gluconate

Concentrations

10% = 100 mg/ml

Indications

1. **Hyperkalemia** "cardio-protective"
2. **Hypocalcemic tetany**

Dose: 100-200 mg/kg/dose IV diluted over 30 min

الوزن بالمل + نفس الكمية بالمل جلوكوز 5% وريدي ببطئ على مدار نصف ساعة

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Potassium chloride

Concentrations

IV preparation = amp 2 mEq/ ml
Oral preparation = syrup 2.2 mEq/5ml

Indications

1. **Shock therapy:** *in symptomatic hypokalemia with ECG changes*

   - **IV:** 0.5-1 mEq/kg over 1- 2 hr = "مل" ربع الوزن او نصف الوزن بالـ
   - **Oral:** typical staring dose 1-2 mEq/kg/day in divided doses with maximum 60 mEq/day

2. **Deficit:**

   - Corrected over 24 hr and dose according to following equation:

   (Desired K – measured K) X Weight X 0.4 = … mEq

3. **Maintenance:** *over 24 hr*

   - Infant & child: IV 20 mEq/L = 1 ml / 100ml of IVF
   - Neonate: IV 1- 2 mEq/kg/day = "مل" الوزن **او** نصف الوزن بالـ

Precautions:

1. Put patient on ECG monitor; hyperkalemia is more dangerous than hypokalemia
2. Oral preparation is safer than IV but not as rapid in urgent situation
3. Oral preparation is bitter tasting and irritating to gastric mucosa so administer with feeding and in divided doses (small frequent amount)
4. Maximum IV infusion rate 1 mEq/kg/hr.
5. Maximum concentration in peripheral IV line: 60 mEq/L
6. Maximum concentration in central IV line: 200 mEq/L
7. Potassium should be diluted in normal saline as dextrose may cause hyperglycemia and insulin release which may aggravate hypokalemia

20 mEq / L	1 ml / 100 ml
40 mEq / L	2 ml / 100 ml
60 mEq / L	3 ml / 100 ml
80 mEq / L	4 ml / 100 ml

Example:

child, 6 year, 20 kg with GE and severe dehydration, serum K = 1.5 with hypokalemic ECG changes with IV peripheral line

IV potassium dose = 0.5 mEq /kg = 0.5 x 20 = 10 mEq >>>> 10 mEq/2mEq **= *5 ml***

Concentration in peripheral line 60 mEq/L = 3 ml / 100 ml

3 ml --------- 100 ml

5 ml ----------??? ml = 166 ml

يحل 5 مل بوتاسيوم كلوريد وريدي في 166 مل محلول ملح ويعطى وريدي بمضخة على مدار ساعتين ويوضع الطفل على مونيتور

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Bicarbonate sodium

Concentrations

8.4% = 1mEq/ml

Indications

1. **Metabolic acidosis** *"not routine "in persistent metabolic acidosis like organic academia*
2. **Hyperkalemia** *if there is metabolic acidosis*
3. **Cardiac arrest** *"not routine" only if the cause of arrest is metabolic acidosis or hyperkalemia*

Dose: 1-2 mEq/kg IV diluted slowly over 2 hrs. "Don't administer with calcium"

الوزن بالمل + نفس الكمية بالمل جلوكوز 5% وريدي ببطئ على مدار ساعتين

1ml of NaHCo3 contains 1 mEq of sodium so remember to remove equal amount of NaCl from the total IV fluids to avoid hypernatremia.

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Corticosteroids

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Dexamethasone

Concentrations

8mg/2ml = 4mg/ml

Indications

1. **Croup** 0.6mg/kg IM single dose (max 16mg)
2. **Status asthmaticus** *"alternative"* 0.6mg/kg/24hr IV/IM for 2 days (max 16mg)
3. **Airway edema** *"extubation with prolonged intubation"*
   Infant & children : 0.25mg/kg/6hr IV (begins 24hr before extubation and continues for 4 doses after extubation)
   Neonate: 0.25 mg/kg/dose IV given 4 hours prior to scheduled extubation and then every 8 hours for 3 doses total.
4. **Brain edema** 0.25mg/kg/6hr IV (max 16 mg/24hr)
5. **Meningitis** 0.15 mg/kg/dose given every 6 hr for 2 days, in the treatment of H. influenza type b meningitis in children older than 6 wk. of age

Hydrocortisone

Concentrations

Solu-cortef
Vial 100 mg powder reconstituted in 2 ml sterile
50mg/ml

Indications

1. **Status asthmaticus:**

   Loading: 5 mg/kg/dose IV شرطة لكل كيلوجرام
   Maintenance: 8 mg/kg/day divided every 6 hrs.

2. **Adrenal crisis:** ***(****withdraw blood sample for hormones before starting treatment)*

   - < 3 yrs. ……. 25 mg IV bolus
   - 3 – 12 yrs. …… 50 mg IV bolus
   - > 12 yrs. ……. 100 mg IV bolus

(Repeat the dose every 6 hours till patient becomes stable and tolerate oral intake the shift to oral; steroids)

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Methylprednisolone

Concentrations	
Solu-medrol vial 500 mg powder يحل في 7.8 مل جلوكوز 5% ليصبح التركيز النهائي 500 مجم / 8 مل	**Solu-medrol vial 1g powder** يحل في 15.6 مل جلوكوز 5% ليصبح التركيز النهائي 1000 مجم / 16 مل

Indications

Status asthmaticus: 1-2 mg/kg/day IV/IM divided /12hrs.

Pulse steroids dose: 20-30 mg/kg once/day for 3-5 days (max 1g/day)

- Myasthenic crisis
- ADEM

يخفف و يعطى وريدي على مدار ساعتين ببطئ مع قياس الضغط قبل وبعد الاعطاء

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

Equations
&
Formulae

By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children's Hospital

PEDIATRIC PARAMETERS AND EQUIPMENT									
	Premie	**Newborn**	**6 mo**	**1 yr**	**2-3 yr**	**4-6 yr**	**7-10 yr**	**11-15 yr**	**>16 yr**
WT (kg)	2.5-3.5	3.5-4	6-8	10	13-16	20-25	25-35	40-50	>50
BAG VALVE MASK	Infant	Infant	Small child	Small child	Child	Child	Child/small adult	Adult	Adult
NASAL AIRWAY (Fr)	12	12	14-16	14-16	14-18	14-18	16-20	18-22	22-36
ORAL AIRWAY	Infant 50 mm	Small 60 mm	Small 60 mm	Small 60 mm	Small 70 mm	Small 70-80 mm	Med 80-90 mm	Med 90 mm	Med 90 mm
BLADE	MIL 0	MIL 0	MIL 1	MIL 1, MAC 2	MIL 1, MAC 2	MIL 2, MAC 3	MIL 2, MAC 3	MIL 2, MAC 3	MIL 2, MAC 3
ETT	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	5.5-6.0	6.0-6.5	7.0-8.0
LMA	1	1	1.5	2	2	2.5	2.5-3	3	4
GLIDESCOPE	1	1 or 2	2	2	3	3	3	3 or 4	3 or 4
IV CATH (ga)	22-24	22-24	20-24	20-24	18-22	18-22	18-22	18-20	16-20
CVL (Fr)	3	3-4	4	4-5	4-5	5	5	7	7
NGT/OGT (Fr)	5	5-8	8	10	10-12	12-14	12-14	14-18	14-18
CHEST TUBE (Fr)	10-12	10-12	12-18	16-20	16-24	20-28	20-32	28-38	28-42
FOLEY (Fr)	6	8	8	8	8	8	8	10	12

ESTIMATED BLOOD PRESSURE BY AGE		
Measurement	**50th %**	**5th %**
Systolic BP	**90 + (age × 2)**	**<u>Neonate:</u> 60 mm Hg** **<u>Infant:</u> 70 mm Hg** **<u>2-10 yr:</u> 70 + (age × 2)** **<u>>10 yr:</u> <90**
MAP	**55 + (age × 1.5)**	**40 + (age × 1.5)**

NORMAL VITAL SIGNS BY AGE			
Age	**Heart Rate (beats/min)**	**Blood Pressure (mmHg)**	**Respiratory Rate (breaths/min)**
Premie	120-170	55-75/35-45 (gestational age approximates normal MAP)	40-70
0-3 mo	110-160	65-85/45-55	30-60
3-6 mo	100-150	70-90/50-65	30-45
6-12 mo	90-130	80-100/55-65	25-40
1-3 yr	80-125	90-105/55-70	20-30
3-6 yr	70-115	95-110/60-75	20-25
6-12 yr	60-100	100-120/60-75	14-22
>12 yr	60-100	100-120/70-80	12-18

ALGRAWANY

Serum osmolality	$2\,[Na] + \frac{glucose\ (mg/dL)}{18} + \frac{BUN\ (mg/dL)}{2.8}$
Potassium correction	(3.5-actual) X weight X 0.4
Sodium correction in hyponatremia	(desired - actual) X weight X 0.6
Hypernatremia	**Table 70.4** Treatment of Hypernatremic Dehydration Restore intravascular volume: Normal saline: 20 mL/kg over 20 min (repeat until intravascular volume restored) Determine time for correction on basis of initial sodium concentration: • [Na] 145-157 mEq/L: 24 hr • [Na] 158-170 mEq/L: 48 hr • [Na] 171-183 mEq/L: 72 hr • [Na] 184-196 mEq/L: 84 hr Administer fluid at constant rate over time for correction: Typical fluid: 5% dextrose + half-normal saline (with 20 mEq/L KCl unless contraindicated) Typical rate: 1.25-1.5 times maintenance Follow serum sodium concentration Adjust fluid on basis of clinical status and serum sodium concentration: Signs of volume depletion: administer normal saline (20 mL/kg) Sodium decreases too rapidly; either: • Increase sodium concentration of IV fluid • Decrease rate of IV fluid Sodium decreases too slowly; either: • Decrease sodium concentration of IV fluid • Increase rate of IV fluid Replace ongoing losses as they occur
Corrected Na in hyperglycemia	Measured Na $+ \frac{1.6\ X(glucose\ in\ mg/ml\ -100)}{100}$
Corrected Calcium in hypoalbuminemia	Total calcium + [(4-albumin) X 0.8]

<table>
<tr><td>Anion gap</td><td>Na - (Cl + HCO3)

(Na + K) - (Cl + HCO3)</td></tr>
<tr><td>Corrected anion gap in hypoalbuminemia</td><td>AG + [(4 −albumin) X 2.5]</td></tr>
<tr><td>Bicarbonate Full Correction Dose (mmol)</td><td><u>Neonate, infant, and child:</u>
HCO3− (mEq) = 0.3 × weight (kg) × base deficit (mEq/L)

OR

HCO3− (mEq) = 0.5 × weight (kg) × [24 − serum HCO3− (mEq/L)]

Half correction is recommended</td></tr>
<tr><td>Corrected reticulocyte count in anemia</td><td>Reticulocyte % x (actual hct / desired hct)</td></tr>
<tr><td>Glucose infusion rate (GIR)</td><td>$\frac{Glucose\ concentration\ X\ fluids\ rate}{6\ X\ weight}$</td></tr>
<tr><td>Schwartz equation Estimated GFR (eGFR)</td><td>eGFR (mL/min/1.73 m^2) = kL/Pcr

where k = proportionality constant; L = height (cm); and Pcr = plasma creatinine (mg/dL)

PROPORTIONALITY CONSTANT FOR CALCULATING GLOMERULAR FILTRATION RATE
<table>
<tr><th>Age</th><th>k Values</th></tr>
<tr><td>Low birth weight during first year of life</td><td>0.33</td></tr>
<tr><td>Term AGA during first year of life</td><td>0.45</td></tr>
<tr><td>Children and adolescent girls</td><td>0.55</td></tr>
<tr><td>Adolescent boys</td><td>0.70</td></tr>
</table></td></tr>
<tr><td colspan="2">By Dr. Ahmad Mamdouh Abdelaziz -Beheira Specialized Children’s Hospital</td></tr>
</table>

ETT Size and depth

Neonate:

Table (4-2): Endotracheal tube (ETT) sizes

Gestational age (weeks)	Weight (gm)	Tube size (mm) (inside diameter)	Distance of tip of ETT (6 + Body weight)
<28	<1,000	2.5	7 cm
28-34	1,000-2,000	3.0	8 cm
34-38	2,000-3,000	3.5	9 cm
>38	>3,000	3.5-4	10 cm

Children:

- Size : [Age ÷ 4] + 4
- Depth : [Age ÷ 2] + 12

***Note**: minus the ETT size by 0.5 mm if cuffed ETT is used*

Body surface area (BSA) = m^2

- $\sqrt{\frac{\text{height (cm) x weight (kg))}}{3600}}$
- $\frac{4\,\text{weight} + 7}{weight + 90}$
- Neonate:

Weight(kg)	Body Surface Area (m^2)
0.6	0.08
1	0.1
1.4	0.12
2	0.15
3	0.2
4	0.25
BSA (m(2)) = (0.05 x kg) + 0.05	

Insensible water loss (IWL)

- Infant and pediatrics: 400 ml / m^2 / day
- Neonates

Birth weight (g)	Insensible Water Loss (mL/kg/d)
<750	100–200
750–1000	60–70
1001–1250	50–60
1251–1500	30–40
1501–2000	20–30
>2000	15–20

Acid base equations

Validity of ABG

Kassirer-Bleich equation: "modified Henderson Hasselbalch equation"

- $[H^+] = \frac{PCO2}{[HCO3-]} X\ 24$

  - Calculate hydrogen ion concentrating from this equation
  - Determine expected pH from pH/H^+ scale
  - Compare between expected pH and measured pH in ABG
  - If the two ABGs are not consistent, there is lab error

pH/H^+ scale							
pH	H^+	pH	H^+	pH	H^+	pH	H^+
6.80	159	7.04	91	7.28	53	7.52	30
6.81	155	7.05	89	7.29	51	7.53	30
6.82	151	7.06	87	730	50	7.54	29
6.83	148	7.07	85	7.31	49	7.55	28
6.84	145	7.08	83	7.32	48	7.56	28
6.85	141	7.09	81	7.33	47	7.57	27
6.86	138	7.10	79	7.34	46	7.58	26
6.87	135	7.11	78	7.35	45	7.59	26
6.88	132	7.12	76	7.36	44	7.60	25
6.89	129	7.13	74	7.37	43	7.61	25
6.90	126	7.14	72	7.38	42	7.62	24
6.91	123	7.15	71	7.39	41	7.63	23
6.92	120	7.16	69	7.40	40	7.64	23
6.93	118	7.17	68	7.41	39	7.65	22
6.94	115	7.18	66	7.42	38	7.66	22
6.95	112	7.19	65	7.43	37	7.67	21
6.96	110	7.20	63	7.44	36	7.68	21
6.97	107	7.21	62	7.45	35	7.69	20
6.98	105	7.22	60	7.46	35	7.70	20
6.99	102	7.23	59	7.47	34	7.72	19
7.00	100	7.24	58	7.48	33	7.74	18
7.01	98	7.25	56	7.49	32	7.76	17
7.02	96	7.26	55	7.50	32	7.78	17
7.03	93	7.27	54	7.51	31	7.80	16

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Acid base compensations

Normal Values Of Arterial Blood Gases	
pH	7.35-7.45
PCO_2	35-45 mm Hg
[HCO_3^-]	20-28 mEq/L

Appropriate Compensation During Simple Acid-Base Disorders

DISORDER	EXPECTED COMPENSATION
Metabolic acidosis	$PCO_2 = (1.5 \times [HCO_3 -]) + 8 \pm 2$
Metabolic alkalosis	PCO_2 increases by 7 mm Hg for each 10 mEq/L increase in serum $[HCO_3 -]$
Respiratory Acidosis	
Acute	$[HCO_3-]$ increases by 1 for each 10 mm Hg increase in PCO_2
Chronic	$[HCO_3-]$ increases by 3.5 for each 10 mm Hg increase in PCO_2
Respiratory Alkalosis	
Acute	$[HCO_3-]$ falls by 2 for each 10 mm Hg decrease in PCO_2
Chronic	$[HCO_3-]$ falls by 4 for each 10 mm Hg decrease in PCO_2

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Mechanical ventilation formulae

PaO_2/FiO_2	Normal > 400 200 – 300: acute lung injury < 200: ARDS
MAP	**Mean airway pressure:** $$= \frac{[TI \times PIP] + [TE \times PEEP]}{Ttot}$$
Oxygenation index (OI)	$$= \frac{MAP \times FiO2 \times 100}{PaO2}$$ -If > 15 : severe respiratory compromise -If > 20 : ARDS & need HFOV -If > 40 : need ECMO
PAO_2	**Partial pressure of Oxygen in alveoli:** $(713 \times FiO_2) - (PCO_2/0.8)$
A-a gradient	**Alveolar arterial gradient** = $PAO_2 - PaO_2$ PAO_2: calculated from PAO_2 equation PaO_2: measured via ABG Normal : 20 If increases indicates alveolar block

REFERENCES

The Harriet Lane Handbook the Johns Hopkins Hospital 22nd Edition - April 22, 2020

Nelson Textbook of Pediatrics 21 EDITION

GOMELLA'S Management, Procedures, On-Call Problems, Diseases, and Drugs EIGHTH EDITION

IBM Micromedex NeoFax 2020

BNF for Children 2020-2021

Pediatric Critical Care Manual Wolter Kluwer (January 1, 2018)